T.E. SEM VI / MECH / CBSGS / MAY 2017 / 14.06.2017

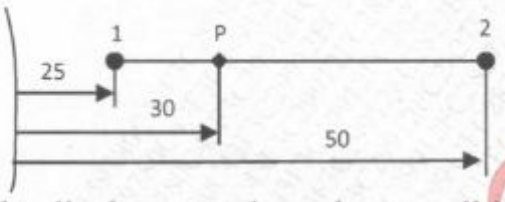
Q.P. Code:18542

(3 Hours) **Max. Marks: 80**

Note:

1. Question 1 is Compulsory
2. Solve any three from remaining five
3. Figures to right indicate full marks
4. Assume suitable data if necessary

Question No.		Max. Marks
Q.1	Attempt any four:	20
	a) Explain the terms "Preprocessor", "Solver" and Postprocessor"	
	b) Explain the characteristics of shape function.	
	c) A 1D spar element having a linear shape function is as shown below. Find the natural co ordinate of point P. If the temperature at node 1 is 50°C and at node 2 is -20°C, find the temperature at point P.	



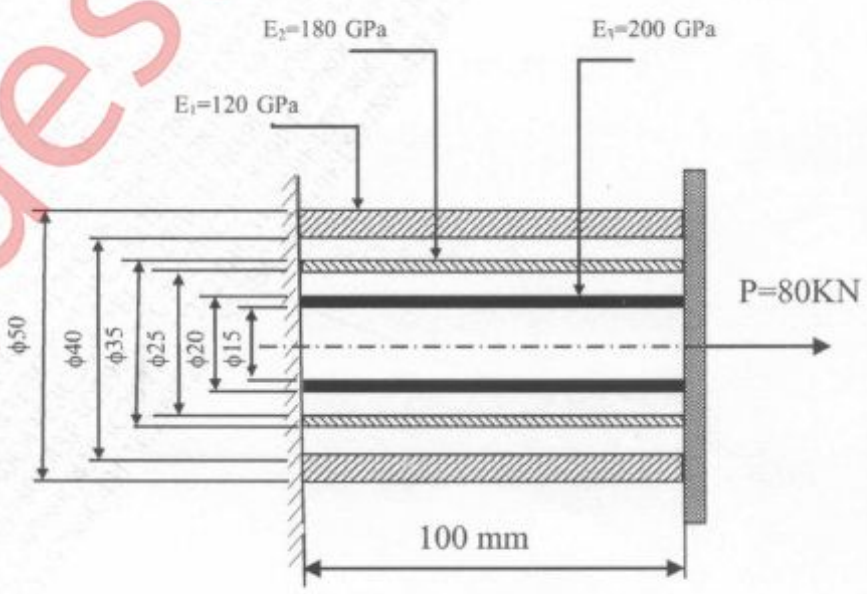
	d) Mention the displacement boundary conditions for different support condition – free, fixed, roller and pinned.	
	e) What do you mean by consistent and lumped mass matrices?	
Q.2	a) Solve the following differential Equation using Galerkin Method.	10

$$\frac{d^2u}{dx^2} + 5 = 0 \text{ for } 0 < x < 1$$

Boundary Conditions are: u = 0 at x = 0 and $\frac{du}{dx} + u = 0 \; at \; x = 1.$

Find u(0.2) and compare with exact solution.

	b) Three concentric rings of different materials are joined together as shown in figure. Determine the displacement at the free end.	10



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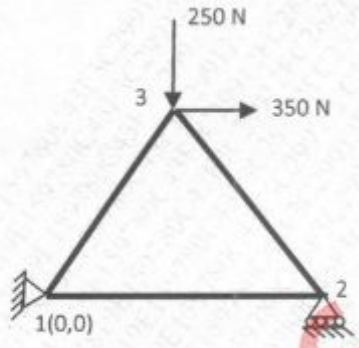
Q.3 a) Write a note on skyline and banded matrix of storing data. 6

b) A three bar equilateral triangular truss has the three members of length 1m each. The bottom support are 1 and 2, whereas the top joint is 3. Support at the end 1 is fixed, while end 2 has a roller support. It is subjected to load as shown. Assuming the modulus of elasticity of the material as 2 x 10^5 N/mm^2 and the cross sectional area as 600 mm^2, determine 14

1. Displacement at each node.
2. Stresses induced in each element.
3. Reaction at supports



Q.4 a) Using R-R Method mapped over general element solve, 10

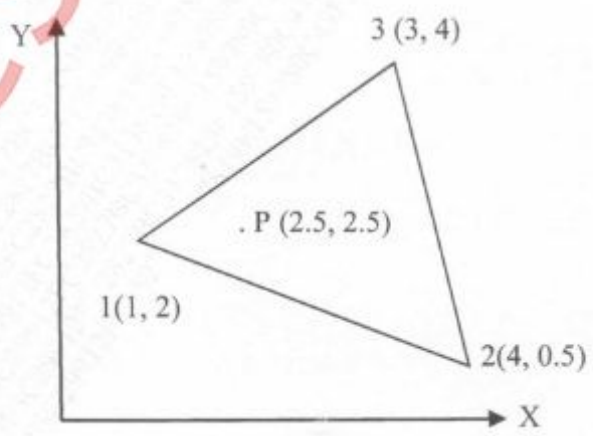
$$\frac{d}{dx}\left(a\frac{du}{dx}\right) + bu + c = 0; 0 \le x \le L$$

Global boundary conditions are, u(0) = u_0 and $a\left(\frac{du}{dx}\right)\Big|_{x=L} = 0$

Use Lagranges Linear shape functions.

b) Find the deflection and slopes at nodes and reactions at supports for the beam as shown in figure. The beam is fixed at node 1, has a roller support at node 2 and has an elastic spring support at node 3. Assume E = 210 GPa and I = 2 x 10^4 m^4 throughout the beam. 10

Q.5 a) The nodal coordinate of the triangular element for ground water simulation is as shown in figure. The nodal values of hydraulic heads (ϕ) at the nodes are (3.5, 2.2, 4.4) respectively. Find the value of the hydraulic head at pint P. 10



10

b) A constant strain triangle element has the nodal coordinates (1, 2), (4, 0.5) and (3, 4) for i, j & k nodes respectively. The element is 2 mm thick and is of material with properties E=70GPa and Poisson's ratio 0.3. Upon loading of the model, the nodal deflections were found to be:

$u_i = 100\mu m$	$u_j = 75\mu m$	$u_k = 80\mu m$
$v_i = -50\mu m$	$v_j = -40\mu m$	$v_k = -45\mu m$

Determine-

i) The Jacobian for (x,y)-(ξ,η) transformation
ii) The strain-displacement relation matrix
iii) The strains
iv) The element stresses.

Q.6 a) Derive the shape functions for a linear quadrilateral element and show it's variation over the element. 10

b) Find the natural frequency of axial vibrations of a bar of uniform cross section of $30mm^2$ and length 1m. Take $E = 2 \times 10^5$ N/mm^2 and $\rho = 8000$ kg/m^3. Take two linear elements. Compare the natural frequencies with exact frequencies. 10